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Generation of business process model views

Artur Caetano^{a*}, Carla Pereira^b, Pedro Sousa^{a,b}

^a*Instituto Superior Técnico, Technical University of Lisbon,
Av. Rovisco Pais, 1049-001 Lisboa, Portugal.*

^b*Link Consulting, Av. Duque de Ávila, 23, 1000-138 Lisboa, Portugal.*

Abstract

Instead of having a single process model and generating several views from the same model, organizations tend to create separate models for the same business process. As a result, the multiple models may lack consistency or effort is required to keep the multiple models consistent. Moreover, the ability to effectively analyse and communicate a business process model depends on the ability to create customized views that isolate and focus on specific concerns. In this paper, we describe the core concepts and a tool to generate consistent business process views from a single process model according to six communication questions: what, where, when, why, who and how.

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Keywords: business process modelling; views; viewpoints; traceability; alignment; ISO 42010

1. Introduction

Business process management plays a central role at operational, organizational and technological levels [1-3]. Process modelling produces abstract descriptions of business processes that are a central asset to the organization as they enable its specification, documentation, analysis and engineering through multiple paradigms, languages and techniques [3-7]. However, process modelling languages are criticised due to the lack of mechanisms to deal with domain changes and with the integration of requirements from multiple stakeholders

* Corresponding author. Tel.: +351-21310044 ; fax: +351-213100445
E-mail address: artur.caetano@ist.utl.pt

[8-11]. Business processes specify the way organizations coordinate actors and resources to operate activities that provide services and products to clients. Such coordination involves different areas of decision within the organization, each with different concerns and needs. As a result, these areas may adopt views of the organization that are not shared as they address different concerns and are designed according to possibly different principles. Business process management solutions are mainly used to model and automate activities, and most include at least a process modelling tool and a repository. Process automation requires a detailed representation of processes activities, actors, rules, security concerns, and many other operational aspects that can be fully or partially automated. Auditing the conformance of business process requires detailed representations such as indicators, metrics, controls points and outputs. This means that the same business process is observed from multiple points of view. For instance, from an operational perspective a model requires detailing business rules, control and data flow so that the steps and conditions required to achieve an objective are explicit. But from a systems perspective, a model may require instance level information so that shared resources and task priorities can be assessed. And from a user perspective, a model should express her authority roles and responsibilities. To facilitate the consistent modelling of business processes from different perspectives, this paper proposes a tool that enables to generate views from the same business process model according to the requirements of its stakeholders. Hence, the approach can be considered an application of ISO 42010 [12] to business process modelling. ISO 42010 states that a view addresses one or more of the concerns of the system stakeholders. A view is a partial expression of a system's architecture with respect to a particular viewpoint. A viewpoint establishes the conventions by which a view is specified, depicted and created.

The remainder of this paper is structured as follows: the next section reviews related work. Section 3 introduces the components of the business process view generator and section 4 describes a scenario of application of the tool. Finally, section 5 summarizes the paper.

2. Related Work

Business process modelling notations deal with describing business processes. Techniques such as flowcharts [13], state charts [14], Event Process Chains (EPC) [15], UML Activity Diagrams [16] and the Business Process Modelling Notation [17] define specific constructs to specify and represent business processes. For instance, in BPMN, processes are composed by sub-processes, activities, decision points, data resources, messages and events. However, since the concept of sub-process is hierarchical, it can be used to reduce complexity as it provides different levels of detail and complexity through functional decomposition. But this is a simplistic mechanism since functional decomposition may not be applied to the remaining elements of BPMN, such as data and actors. An EPC is an ordered graph of events and functions that describe the sequencing and interaction between data, process steps, systems, organizational structure and products. An EPC always starts and ends with events which define the state or condition under which a process starts and under which it ends. One could envisage the same hierarchical concept of process steps but there is nothing said in the EPC notation explicitly. The same is true for flowcharts and Petri Nets. Business process reference frameworks, such as Process Classification Framework [18], Value Reference Model [19], Supply Chain Operation Reference [20] and the MIT Process Handbook [21] are another example of processes descriptions that prescribe hierarchical decomposition of business processes.

Most process modelling techniques use the notion of functional decomposition, i.e. recursively breaking down a process as sub-activities. Other abstraction technique is the concept of specialization. While a sub-activity is a *part of* a process, a specialization represents a *type of* a process, i.e. a different way of doing it. This means processes may be arranged as a hierarchical structure with generic processes at one end and specialized processes at the other. However, this does not solve the problem being addressed in this paper be-

cause different views and concerns of different stakeholders are addressed by level of detail but by focussing on providing detail over individual aspects.

3. The View Generator

This paper describes a process view generator that produces diagrams according to different concerns. This capability is provided by a tool which generates dynamic views from a business process repository serving as knowledge base. The view generator is composed by three main logical components: the repository model, the controller and the viewer. Each of these components is described in the next three sections.

3.1. Repository Model

The Zachman framework describes an architecture using a two dimensional classification matrix based on the intersection of six communication questions (what, where, when, why, who and how) with six rows according to reification transformation that represents a view of the solution from a particular perspective such as the planner's or the designer's perspective [22, 23]. It is important to notice that the Zachman framework specifies that each model (i.e. cell) of the matrix is represented by a primitive two-dimensional model which is a combination of a question with a perspective. However, in this paper we are not using such specification but only the six 5W1H communication questions as independent concerns for the decomposition of a business process [10, 24, 25]. Thus, each of these six dimensions focusses on a specific and independent concern. The combinations of these concerns characterize aggregate parts of the process or the process as a whole [26]. Fig. 1 shows the concepts associated with each of the 5W1H dimensions.

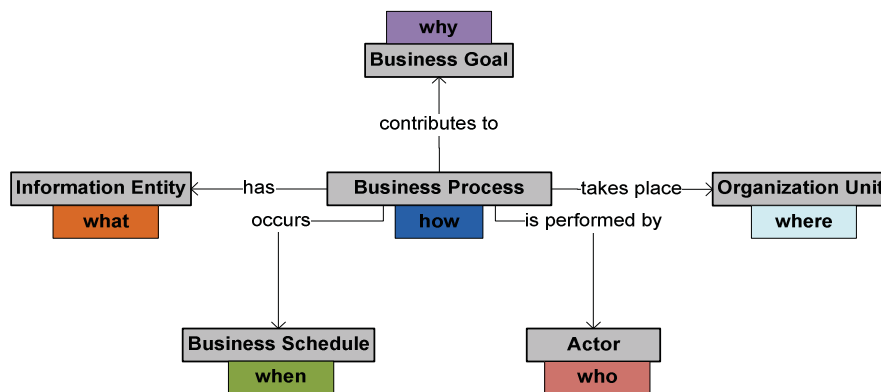


Fig. 1. The six concerns and the associated concepts within the repository model.

- **How.** A *business process* is defined as a set of connected actions which consumes (inputs) and produces (outputs) tangible or intangible artefacts, is performed by people, contributes to achieve goals, takes place in a specific location and occurs during a period of time. A business process can be functionally decomposed in as many levels of detail as required. Modelling methods usually prescribe two or three levels of decomposition and use different naming conventions for each level (e.g. process, activity, task). In this paper we consider the concept of business process to the same regardless of the level of decomposition.
- **Why.** A *business goal* is an objective that may be decomposed. Each goal may be associated to the business processes that contribute to its achievement.

- **Where.** An *organizational unit* defines the organizational structure. It may describe a logical unit (e.g. department) or a physical or geographical location.
- **When.** A *business schedule* is a plan that specifies temporal restrictions for performing business processes. Thus, it comprises the events that are important for the organization. Schedules are bound to business processes.
- **What.** An *information entity* represents the information about a person, place, concept, thing or event that has meaning in the context of the business, and about which data may be stored [27].
- **Who.** An *actor* plays one or more *roles*. Actors may represent people or systems, including information systems and machines. An actor may play multiple roles and the same role may be played by different actors [26, 28].

These concepts can be arranged as hierarchic structures as defined by Krogstie and Sølvyberg [29]. Such trees are strictly hierarchical graphs. Fig. 2 shows an application of abstracting a business process to a depth of four decomposition levels. Note that the concept of business process remains exactly the same regardless of the level of detail.

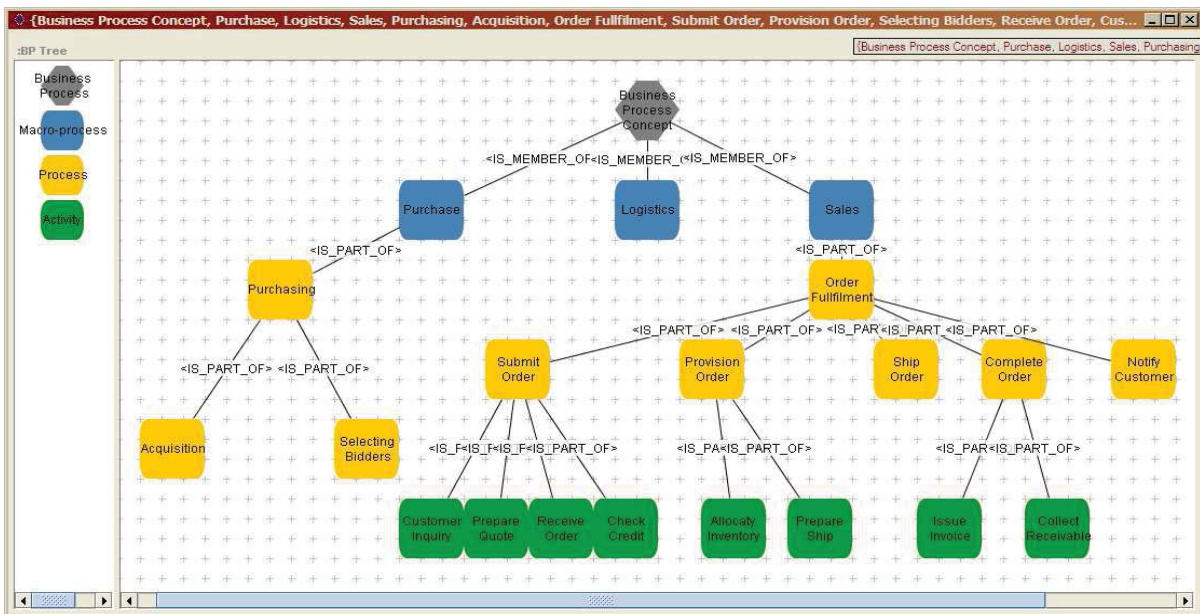


Fig. 2. A decomposition of a business process to a depth of four levels.

3.2. Controller

The controller manages the 5W1H dimensions and the level of detail (i.e. the depth of the hierarchical structure) that is used to generate a view. Therefore, the controller specifies the viewpoint used to produce the view. Fig. 3 shows an example where the dimensions *how*, *where* and *who* are selected. The level of detail (LoD) is 4, 4, 6, respectively. The available dimensions as well as the available level of detail associated to each specific dimension are dynamically captured from the repository.

Such an approach to specify the viewpoint pertaining to a view makes possible expressing the concerns of a stakeholder. For instance, generating a view that depicts where a process is executed and who is responsible for its execution requires setting the *how*, *who* and *where* dimensions. An example of such view is shown in

Fig 4. To generate a view over the same model that only focuses on where a process is being executed the dimensions *how* and *where* are selected (v. Fig. 5). Note that these different views are consistent with the model specified in the repository as they are generated from the same base data.

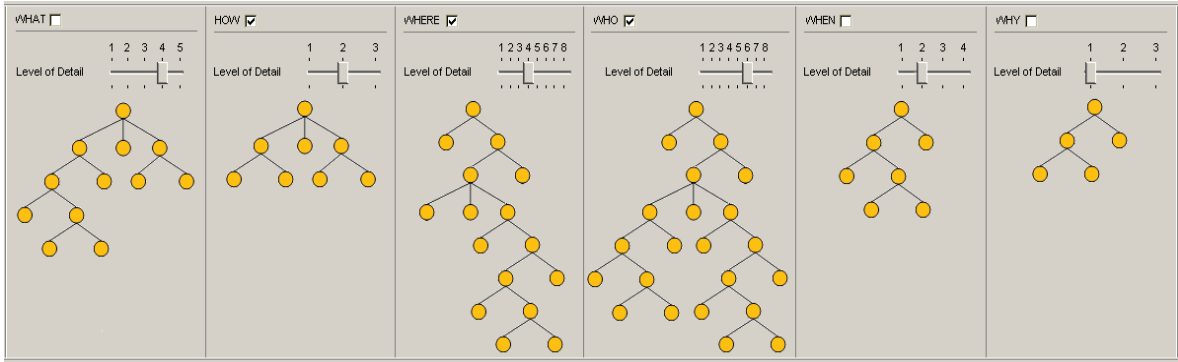


Fig. 3. The main interface of the controller.

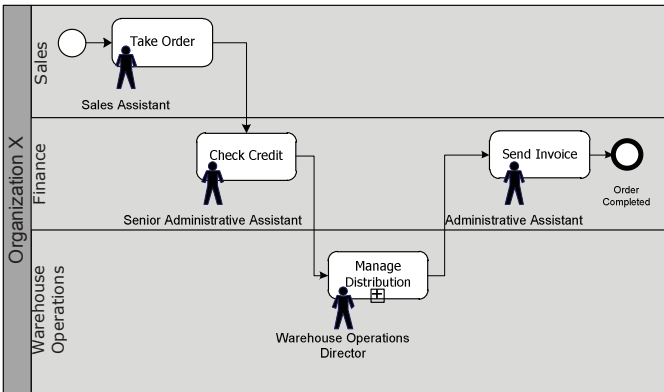


Fig. 4. A view according to the *how*, *where* and *who* dimensions.

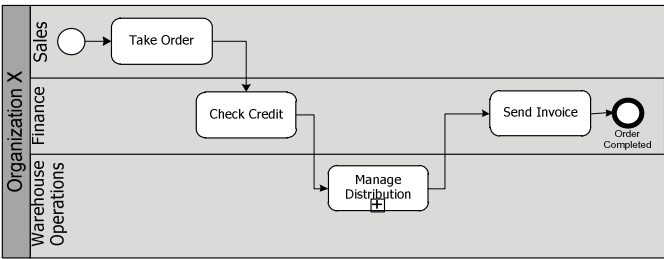


Fig. 5. A view according to the *how* and *where* dimensions.

3.3. Viewer

The viewer presents the results extracted from the repository based on the controller selection. The viewer component enables specifying a set of graphical symbols to depict each diagram element. Therefore, it is pos-

sible to produce multiple visualizations based on the same model and on the same viewpoint as specified in the controller. Therefore, the diagrams that are generated are independent of the notation. Currently, the viewer supports the following types of views:

- **Hierarchical.** Displays the functional decomposition of a process.
- **End-to-end.** Displays the elements composing a process.
- **Combined.** Combines any of the six dimensions (i.e. process, information, organizational unit, actor, schedule, goal) using any level of detail. The resulting view combines the concepts and shows their relationships.

Fig. 5 shows a view generated according to four dimensions: *what* (LoD 1), *how* (LoD 2), *where* (LoD 2) and *who* (LoD 2). For instance, the view depicts actor 1.3 performing process 3 which takes place at the organizational unit 1.2. Such combined views structure a process as a series of dimensions since and are able to respond to different concerns such as identifying the activities for which an actor is responsible, the activities related to a given set of information entities or the activities being performed in a specific organizational unit (in this case a specific physical location).

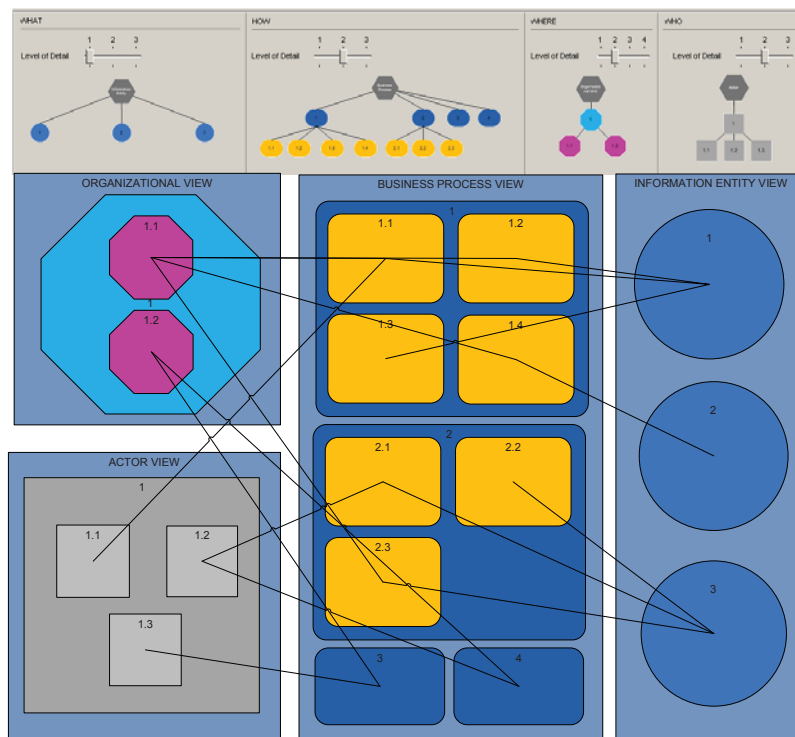


Fig. 6. View generated according to the dimensions what, how, where and who.

4. Scenarios of Application

This section presents two application cases of the view generator that considers that organization X is divided into Sales, Finance and Warehouse Operations units. For simplicity sake, the scenario will only address three dimensions (*how*, *where* and *who*) with level of detail between 1 and 3.

4.1. Case 1

In Scenario A (v. Fig. 7), the controller is parameterized with these values: *how*/LoD 2; *where*/LoD 2, *who*/LoD 1. In Scenario B the values are: *how*/LoD 1; *where*/LoD 2, *who*/LoD 1. These diagrams are being visualized using a BPMN-inspired notation: the horizontal lanes are used to depict the *where* dimension. The *how* dimension is represented with activities (rounded rectangles) and control flow directional connectors. The actor roles (*who* dimension) are represented as superimposed stick figure actors. In scenario A the same actor role *Warehouse Operations Director* performs two activities (*Package Order* and *Ship Order*). In scenario B these two activities are aggregated as one activity (*Manage Distribution*) because the level of detail was decreased from 2 to 1 on the *how* dimension. The remaining activities cannot be further aggregated due to level of detail on the *where* and *who* dimension. For instance, *Check Credit* and *Send Invoice* cannot be aggregated as a single activity because they are performed by different actors (*who* dimension). If the level of detail of the *who* dimension was set to zero then these activities would have been aggregated.

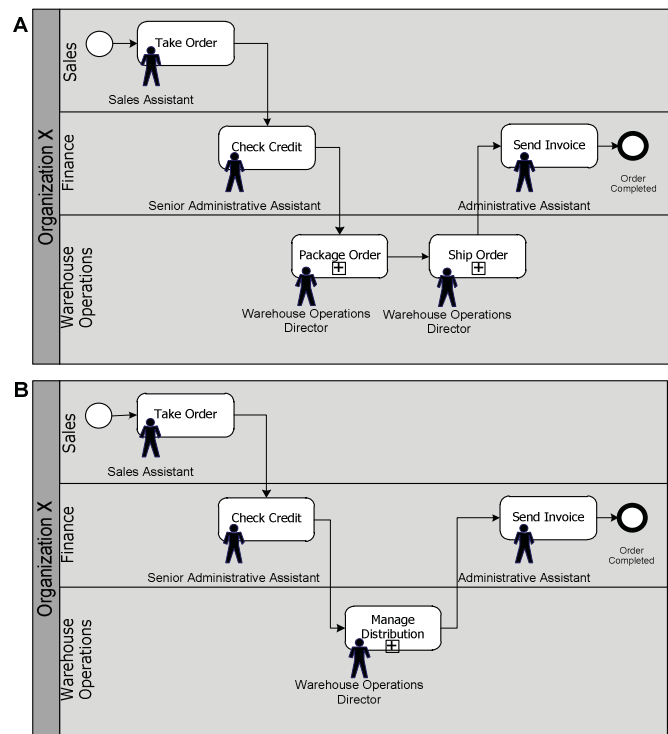


Fig. 7. Scenarios A and B share the same dimensions but scenario B has LoD 1 on the *how* dimension whereas scenario A as LoD 2.

Fig. 8 shows a view based on: *how*/LoD 2; *where*/LoD 3, *who*/LoD 2. Because of this configuration the business process diagram generated presents the *Inventory Officer* and *Administrative Officer* as sub-divisions of *Warehouse Operations*. This is the result of increasing the level of detail related to the *where* (organizational unit) dimension. The actor roles are also further detailed as the LoD increases to 2 when compared to 1 as depicted earlier on Fig. 7. This means that the *Inventory Control Manager* is now shown as responsible for performing the activity *Package Order* and the *Distribution Manager* responsible for *Ship Order*. This setup implies that the activities need to be further detailed in order to keep up with the detail of the *where* dimen-

sion. In this case, the *Manage Distribution* activity is decomposed as *Package Order* and *Ship Order*, each being executed in different locations.

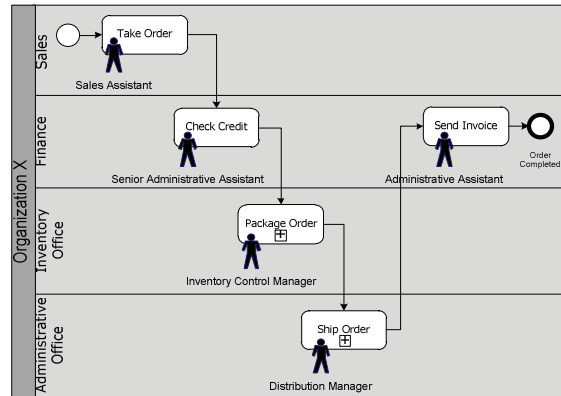


Fig.8. Result of increasing the level of detail on the who and where dimensions.

Fig. 9 shows the full decomposition of the process *Manage Distribution* being used throughout this example. Here, the viewpoint is configured with *how/LoD3*, *where/LoD 2*, *who/LoD 3*.

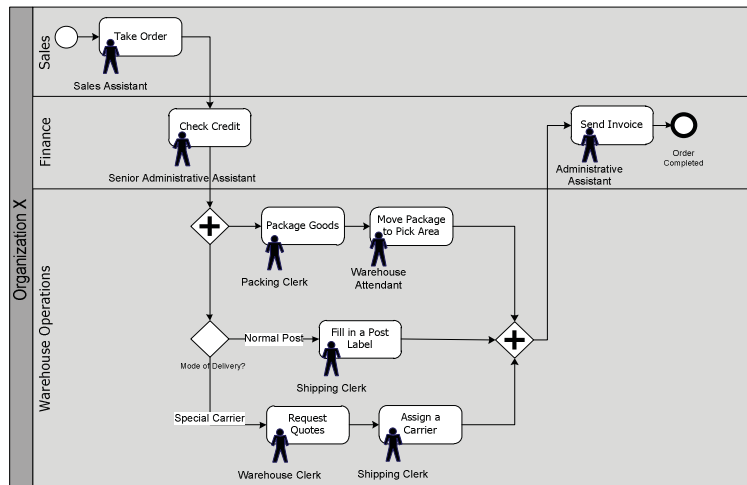


Fig. 9. The scenario with the maximum detail on the how dimension.

4.2. Case 2

This case demonstrates the generation of business process diagrams based on different stakeholder perspectives. In this example, the stakeholder requires a set of views from the perspective of quality auditor regarding the *Inventory Office* unit. Thus, his concern relates to the activities that are performed exclusively in the context of the auditing domain. The *Inventory Control Manager* is responsible for the *Inventory Office*. His concern is to have represented the activities that he manages. To this role is enough to know that fulfilling a package order requires first to package the goods and then to move the package to the pick area. The first process is performed by the *Packing Clerk* role and the second by the *Warehouse Attendant* (see Fig. 10, A).

Each of these processes can be further detailed as depicted in Fig 10. When the *Packing Clerk* is performing the process of *Package Goods* he plays different roles. To pack the goods the clerk first needs to know where the material is located, then he must select the material to package and finally verify if the material which was located and was selected it is according to the order. Even though, this actor could be the same person executing each of these activities, the actor assumes different roles (see Fig. 10, B). In the *Locate Materials* activity he needs to consult the inventory information system as a *Stock Clerk*. The process continues until the package is finally moved to the pick area.

From the perspective of quality auditing the process described in Fig. 10 C presents unnecessary detail. Therefore, a view that solely focuses on the quality auditing roles *Quality Controller* and *Quality Clerk* must be generated. This view focus on the activities that are related to the quality concern and suppresses the other activities that are not relevant for the quality auditor roles. The resulting process is shown in Fig. 11.

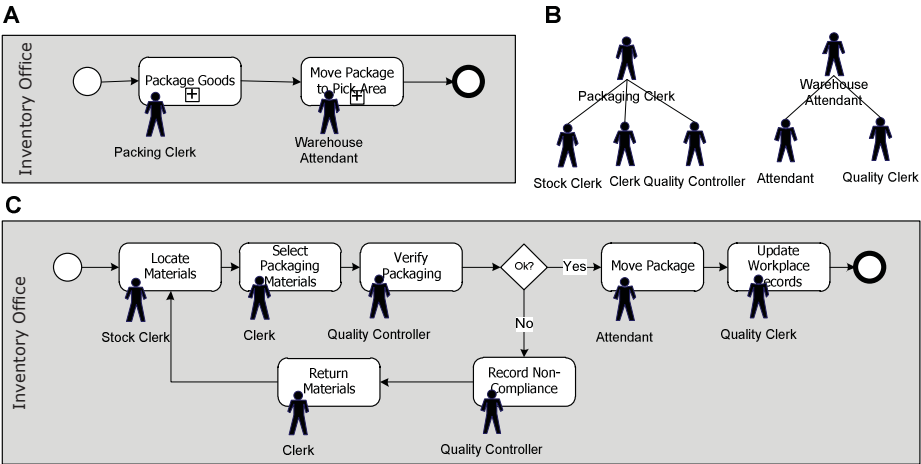


Fig. 10. A describes the top-level activities composing the Package Order process whereas C details each of its sub-processes. B represents the actor roles on the who dimension.

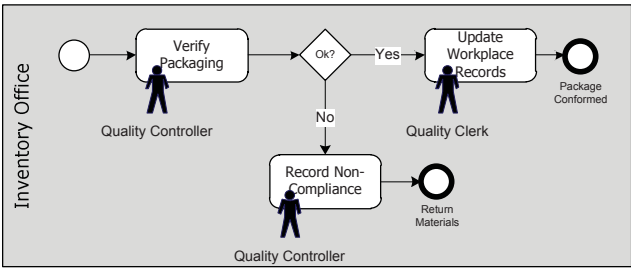


Fig. 11. The Package Order process from the perspective of the two quality auditing roles.

5. Conclusion

This paper presented an approach to generate consistent views over a business process according to six concerns: what, where, when, why, who and how. Each concern may be decomposed according to its level of detail. This approach makes possible specifying viewpoints that respond to the concerns of stakeholders by producing views that are dynamically generated and updated according to the information in a process reposi-

tory. The generated views are inherently consistent and the effort to produce new views is low. The approach was instantiated in a prototype tool that comprises a repository, a controller and a viewer. Although not addressed in this paper, the approach and tool also make possible constructing the base model from the integration of multiple views, therefore enabling the incremental round-trip design of a business process.

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